

A guide to Snowy Plover nest predators, their tracks and behaviors, along the Oregon coast.

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The Western Snowy Plover (*Charadrius nivosus nivosus*) breeds along the Pacific Coast in California, Oregon, and Washington and at alkaline lakes in the interior of the western United States (Page *et al.* 1991). Loss of habitat, predation pressures, and disturbance have caused the decline of the coastal population of Snowy Plovers and led to the listing of the Pacific Coast Population of Western Snowy Plovers as threatened on March 5, 1993 (U.S. Fish and Wildlife Service 1993). Oregon Department of Fish and Wildlife lists the Western Snowy Plover as threatened throughout the state (ODFW 2009). In Oregon, monitoring from Sutton Beach, Lane Co. to Floras Lake, Curry Co. (Figure 1), has shown that predators are the main cause of nest failure (Lauten *et al.* 2015, 2016, and 2017). The causes of chick and adult mortality are more difficult to determine, however the same suite of predators that impact plover nests likely impact chick and adult survival.

Identifying predators impacting nest, egg, chick, and adult survival is important for managing Snowy Plovers (USFWS 2007). Since nests are not mobile and are in sand, evidence of predation is often visible at the nest site and is the best indication of which predators are on site and affecting plover populations. To assist biologists and managers in determining causes of nest failure, we collected photographs of tracks and depredated plover nests on the Oregon coast. This guide illustrates predator tracks and nest predation events found on Oregon beaches, where Snowy Plovers breed and are year-round residents. The information in the guide describes individual species tracks, size, characteristics, and other information that can aid in identifying the track. Details include photos and a written description of what is observed for each species, and where applicable, comparison to other species that have similar features.

Some species' tracks can look very similar in appearance but vary in size, such as Turkey Vulture and Whimbrel tracks. We used photographs with measurements in centimeters to show differences in size. It is important to remember tracks will vary in size based on whether the sand is wet or dry, and individual variation of the animal. For example, coyotes, one of the larger mammals that may negatively impact plovers, can have variable track sizes based on the sand conditions and size of the individual.

We consider this a working document that can be built upon and elaborated on as needed. In Oregon, as the plover population has increased, predator composition and individual species have, in some cases, changed, and/or increased. For example, in Oregon gulls have only become a predator of plover eggs in the past few years, and only at certain nesting sites. Changes in the composition of predator populations can and do change over time at different beaches.

Avian tracks are described first, and then mammalian tracks. There are both avian and mammalian species described that are not known predators of plover chicks, eggs, or adults. They are included because they are observed on the beach or nesting areas, and are described to differentiate one species from another.

Avian Species

Bald eagles (*Haliaeetus leucocephalus*) are uncommon-to-regularly observed on plover beaches, however they have not been recorded as a predator of plovers or their eggs. Eagles have one of the largest tracks observed. Species with similar sized tracks that may be confused with eagles include Great Blue Heron (*Ardea herodias*) and Turkey Vulture (*Cathartes aura*). None of these three species have been documented negatively impacting plovers, but all are regularly observed on Oregon beaches. Eagles are often observed in small numbers, especially at sites like Tenmile or New River (Figure 1). They feed on dead fish, seal pups, or other carcasses that wash up on the beach. Common Ravens (*Corvus corax*) are often observed in association with eagles, as ravens will attempt to steal or scavenge some of the prey or carcasses the eagles feed on. Eagles, like ravens, will walk around on the sand picking and pulling at plastic, glass light bulbs, and various colorful objects in and on the sand.

Figure 2 is a Bald Eagle footprint. Eagle footprints range from 15-16.5 cm long nail-to-nail. The toe print is very broad and deep in sand. Three toes are forward, and one toe is back. Nail marks can be noted in the front and back. Drag marks from the nail are prominent.

Figure 3 shows Bald Eagle tracks walking on the sand. Note there are three toes forward and the front of the back toe print is prominent, and the back nail leaves a consistent drag mark in the sand.

Corvids are commonly observed on the beaches in Oregon. Both Common Raven and American Crow (*Corvus brachyrhynchos*) are year-round residents along the coast. Corvids are the main predators of plover nests in Oregon (Lauten *et al.* 2015, 2016, and 2017). Corvids are inquisitive and persistent predators. Observations of ravens indicate that once they have found plover nests, they will regularly return to continue hunting for more nests. One or two individual ravens can depredate numerous nests at one site in just a few days. Although observations of ravens depredating chicks are rare, they are a serious threat to plover chicks.

Corvids often associate in flocks of 10 to 100 and are opportunistic scavengers. They will eat a wide variety of food, and therefore spend much time walking around on the beach and plover nesting areas in search of food, picking at items as they forage. Both species will also forage at the edge of the water, and dig in the sand for mole crabs, thus they fly between the edge of the water and the habitat east of the foredune area, flying over plover nesting areas. Evidence of corvid activity is often prominent, as they walk all around the nesting area. Other avian predators such as owls and hawks tend to walk on the beach less, often only landing on the beach or on a piece of wood near a nest, and walking only a short distance before flying off.

Common Raven is a regularly observed predator of plover eggs on coastal Oregon beaches. They are more common at some sites than others, often observed singly or in pairs, but can be observed in groups of 10-20 plus individuals at one time. Ravens have three toes forward, and one toe back. A well defined track will show the foot pads appearing segmented, and often drag marks from either their front or back toenail or both. The track size of a Raven is between 8-10.5cm, not including the nail marks, and ranges more widely, 15-21cm, with the nail marks.

Ravens often hunt by flying low over the beach and foredune nesting habitat. They may observe the movement of female plovers sitting or leaving a nest, or they simply observe the nest, and drop down around the vicinity of the nest until they find the eggs. Their tracks can indicate a walking stride, or they hop leaving tracks that appear side by side. When they get excited about food, they often are observed repeatedly jumping in the air and landing.

Figures 4 and 5 show two different sets of raven tracks. Both photos show the segmented toes and drag of the nails. Note the nail is dragging on the front toe in Figure 3, and the nail is dragging on the back toe in Figure 4.

Figures 6-10 show raven activity around various tidal debris. Ravens are very inquisitive as they search for food. Note how they peck at debris and flip over kelp, plastic bottles, and other marine debris. Ravens tend to be messy around a nest site, sometimes digging into the nest bowl, walking around repeatedly, flipping items, or pecking at pieces of wood and debris. They normally swallow eggs whole so there is typically no evidence of the eggs. Figures 11 and 12 show raven activity at depredated plover nests.

Raven tracks can be confused with Northern Harrier (*Circus hudsonius*), Peregrine Falcon (*Falco peregrinus*), or Great Horned Owl (*Bubo virginianus*) tracks. Raven tracks have three toes close together pointing forward, while Northern Harrier tracks are more splayed. Ravens have prominent drag marks from both the forward and rear toe nails. While nail marks can be observed in some cases with harrier tracks, they are not commonly seen especially in soft dry sand, and harriers rarely walk around. While there is some overlap in the size of harrier and raven tracks, harrier tracks are typically slightly smaller overall and due to the lighter weight of the harriers, not as prominent in the sand. Harriers rarely show the segmented appearance of the foot pad, which is typically prominent with a raven track.

Peregrine Falcons also have three toes forward and one toe backward like a raven, but while their toe size overlaps with ravens, their toe prints appear to be slightly wider and more robust. The foot pad of a Peregrine Falcon can also show a segmented appearance. The rear toe of a Peregrine Falcon is often not as noticeable as a raven's, and will often be angled to the left or right depending on the foot. Also, in some cases one of the two outer front toes may not be well-defined. Peregrine Falcons will land on the sand where they killed prey and sometimes will consume the prey on the beach, but they do not regularly walk around on the sand. They predominately fly over the beach and foredune while hunting, landing and perching on pieces of wood or stumps.

Unlike ravens, harriers, or falcons, Great Horned Owls have two toes forward, with one toe to the side and one toe backward. Owl tracks are also wider and more robust than a raven's. Great

Horned Owls weigh more than a raven and therefore their print tends to be heavier (Great Horned Owl weight is 910-2500g, raven weight is 689-1625g; Boarman and Heinrich 1999, Artuso et al. 2013). Great Horned Owls are the only species of owl regularly noted on Oregon beaches. While Great Horned Owls will walk around on the sand, it is never as extensively as corvids.

American Crow has a similar track print as a raven. Since they are smaller in size and weight (crows typically weigh 316-620g (Verbeek and Caffrey 2002) they have a smaller track size and are lighter on their feet resulting in toe tracks that tend to show less segmentation. Crow tracks are approximately 6.5-7cm long. Like ravens, they have a habit of walking and hopping around while foraging. Unlike ravens, claw drag marks are not as prominent a feature of crow tracks. While crows can be a persistent plover nest predator, observations seem to indicate that crows are more opportunistic and may not focus as intently on locating plover nests as ravens.

Figures 13 - 15 show crow tracks. Figure 13 shows a well defined track with a segmented pad, and detached nail mark in front of the middle toe. The pad part of the track is 7cm long, and with the nail marks 8.5cm long. It is very similar to a raven track but both the pad and the toe length are smaller.

Figure 14 and 15 are less defined but more typical of crow tracks observed on the beach. The photos do not show a segmented pad and the middle pads of the foot are not visible. Nail marks are visible at the tips of toes, and Figure 14 shows the rear toe nail has left a drag mark.

While crows do walk around foraging on the beach, ravens typically are more curious and more apt to explore wrack items and poke, pull, dig, and chew things on the beach. Crows often do not consume eggs whole, but often leave fragments of shell near the nest location.

Gulls (*Larus sp.*) are an uncommon predator of plover nests along coastal Oregon. ORBIC has photo-documented Western Gulls (*L. occidentalis*) depredating nests at Bandon and New River. There is no photographic evidence of other gull species depredating nests in Oregon, however they are a known nest predator in other locations (particularly California Gulls (*L. californicus*) in San Francisco Bay (R USFWS, *pers. comm.*). Some footprint measurements taken at depredated nests at New River were equivocal but suggest California Gulls may also be responsible for some nest depredations. Evidence of gull depredations around the nests tend to be obvious. They typically land at or near the nest bowl, walk up to the nest and swallow the eggs. Their webbed prints are prominent around the nest bowl, and they will often leave a brief set of running footprints for a short distance before they fly off. The nest bowls are left intact, as they do not disturb or dig in or around it. Due to their quick action and swallowing eggs, there is little to no evidence left at the nest site except for their tracks.

Gull diets are diverse and include fish, invertebrates, eggs, chicks, bivalves, crabs, sea urchins, small vertebrates, carrion, and trash (Marshall 2005, Ehrlich 1988). They may also feed on carrion including their own species.

Gulls have four toes, with toes two to four pointing forward and visible on tracks. Toe one points rearward, and may show as a mark in the sand or not at all (Halfpenny 2008). They have distal webbing between toes two to four. The webbing is relatively straight between the toes,

and between toes two and three they tend to diverge, especially at the tips. Their feet turn slightly inward. The only species that may cause confusion with a gull would be Canada or Cackling Goose (*Branta canadensis* and *B. hutchensii*). As with gulls, they have four toes with three pointing forward and one rearward. Toes two and four tend to converge slightly near the tip (Halfpenny 2008). A goose has claws that are broad and blunt. Canada Geese have large webbed feet (10cm x 8.8cm, Halfpenny 2008). Cackling Geese have smaller feet than Canada Geese due to their smaller size (measurements unknown). Both species of geese randomly land on the nesting areas and often walk extensively in groups, but never actively hunt plover nests.

Gull tracks that were measured around depredated nests in Oregon appeared to be Western Gulls based on size (measurements were typically ca. 7.5-10.5cm x 9cm, length x width). Small Western Gull tracks may overlap in size with California Gulls (measured tracks were between ca. 6.5-7.5cm x 7cm).

Figure 16 shows a typical gull track. Toes two to four are clearly shown with the webbing between the toes. Toe one, the rearward toe, faintly shows the mark of the claw. Different gull species tracks appear the same visually but would show differences in size and walking stride.

Figure 17 is a photo of a Western Gull track on wet sand (compact and hard); the webbing between toes two to four is not visible.

Figure 18 shows a typical walking stride of a set of gull tracks.

Figure 19 shows gull tracks around the remainder of an empty nest bowl. A few faint plover tracks are visible around the nest bowl, as well as gull tracks.

Figure 20 shows gull tracks walking away from a depredated nest.

Figure 21 shows an empty plover nest bowl that was recently depredated, with both plover and gull tracks visible.

Figure 22 shows gull tracks and plover tracks at a depredated nest site (not visible in photo). The plover tracks have a path to the nest, and the gull appears to have landed, swallowed the eggs, and walked off.

Figure 23 shows a depredated plover nest. Note the empty nest bowl, well defined gull tracks, and a few plover tracks coming and going from the nest.

Great Blue Herons are commonly observed on plover nesting beaches in Oregon, including open beaches, spits near river mouths, and adjacent habitat restoration areas. They are opportunistic feeders and their diet is comprised primarily of fish, frogs, aquatic invertebrates, salamanders, lizards, small birds, chicks, and small mammals (Marshall et al 2003, Ehrlich 1988). Herons are occasionally observed hunting prey on plover nesting areas, however they are not documented predators of plover eggs or chicks in Oregon. We have included Great Blue Heron in this document to compare their tracks to other larger birds, i.e. Bald Eagle.

Figure 24 shows a Great Blue Heron track. They are the largest avian track likely to be seen on the beach, and are larger than Bald Eagle tracks. A Great Blue Heron track is approximately 16

cm long. The individual toes of a heron are not as broad as an eagle. Herons have three toes forward and one toe backward, and they have offset toes.

Figure 25 shows the walking stride of a Great Blue Heron. Note the fairly straight line of tracks and the lack of nail drag marks. Heron tracks have a slightly wider gape than eagles.

Figure 26 shows multiple tracks of a Great Blue Heron that was standing in one location on the beach.

Great Horned Owls are year-round residents along Oregon coastal habitat, and their tracks have been recorded at most of the plover nesting sites. Video documentation was recorded from Tenmile, Coos Cty of a Great Horned Owl landing on a nest enclosure and attempting to depredate an adult plover (ORBIC unpubl. data). Owl tracks have been observed within plover nesting habitat and near active nests. In 2016 evidence of a Great Horned Owl depredation of a Ringed-necked Pheasant (*Phasianus colchicus*) on a plover nesting area at Coos Bay during the nesting season was recorded. Due to the mostly nocturnal behavior of owls, it is more difficult to recognize their presence compared to other raptors.

Owls are opportunistic, aggressive predators that will prey upon a variety of animals and will target what is most abundant. Their diet includes small and medium sized mammals, a wide array of bird species including raptors, fish, amphibians, and reptiles (Marshall et. al., 2003, Ehrlich et. al., 1988).

Owls have four broad toes, with two paired and facing forward, one to the side, and a fourth toe that is not fixed so it may face back or out to the side (Halfpenny 2008). The track size varies considerably, from 9-15 cm in length, and there is much variation in length due to weight and size of individuals. Their claws are long and thus the tracks appear to have a claw detached from the foot. Tracks normally have well defined claws, and sometimes the rear claw leaves a drag mark.

Figures 27 and 28 show Great Horned Owl tracks. Note the two toes facing forward are close together, the third toe is off to the side, and the fourth toe is facing back. Owls have relatively thick toes compared to other species of similar size.

Figures 29 and 30 show Great Horned Owl tracks walking a short distance in the sand. Note in the photo the owl tracks cross over a set of plover tracks. Owls will land on the beach and may briefly walk around, and in some situations the owl will fly a short distance to another location where their tracks will be observed again.

Northern Harriers are present throughout the year in Oregon. Harriers winter along the coast and breed in the coastal deflation plains. Wildlife Services specialists have documented harrier nests in habitat adjacent to plover nesting habitat. Photographs from remote cameras have documented harriers depredating Snowy Plover nests. Harriers are regularly observed hunting low over plover nesting areas adjacent to deflation plains, the foredune and the adjacent beach. Plovers and Killdeer (*Charadrius vociferous*) will often pursue and harass a harrier as it hunts low over the nesting habitat.

Photo documentation of harriers depredating nests revealed that harriers often land close to the nest bowl and consume the eggs, and occasionally walk a short distance before flying away. Due to the harrier's small bill and mouth, they are unable to swallow eggs. Harriers bite into the eggs, exposing the contents. Eggshell is not always consumed, with large pieces of eggshell often left in or around the nest bowl, and small pieces of crushed eggshell can often be found in or adjacent to the nest bowl. In some cases, dead chicks may be left in the shell, often with a hole poked into the shell or the shell completely broken open. Eggshell parts, egg contents, or dead chicks are sometimes found within a few meters of the nest bowl or mixed into the sand.

Figures 31 and 32 show depredated Snowy Plover eggs from a Northern Harrier. Note the crushed eggs and the spilled egg contents. Figure 31 shows a dead plover chick that is nearly fully developed.

Several characteristics indicate differences between harrier and raven predations. Ravens swallow or eat the entire egg regardless of whether it is newly laid or a fully developed embryo. Ravens rarely leave any egg material at the nest site due to swallowing the entire egg. Raven tracks are an important sign of raven depredation, as they tend to walk around and explore more of the surrounding habitat than a harrier. Ravens will often dig in and around the nest bowl, and frequently will chew or pulverize other beach debris or wood nearby. Harriers leave much less evidence around the nest site, and the nest bowl generally remains intact. They tend to land at the nest and not walk around much. They do not dig into the nest and tend to be lighter on their feet. If the nest is surrounded by shell hash or vegetation, it is often difficult to see any harrier tracks. Frequently the only harrier tracks will be left around the nest bowl. Plovers will return to the nest to check to see if the eggs are still present, and their tracks will often erase any harrier track that remained, leaving only plover tracks. Sometimes one or two harrier tracks may be visible a meter or two from the nest bowl.

Figure 33 shows a Northern Harrier print. Note toes two to four point forward and toe one points backward. Harriers differs from owls by having three toes pointing forward; owls have two toes pointing forward. The track length of a harrier print is ca. 7.5-9 cm long. Claw marks are clearly visible in this photo, likely due to the sand being compact. If the sand is dry and soft the claws can be visible, and the toes may look more robust and slightly thicker. Well defined raven tracks typically are segmented in appearance and frequently have a rear toe nail drag mark. The forward pointing toes of a raven appear closer together than a harrier. Raven tracks are larger than harrier tracks.

Figure 34 shows a Northern Harrier track in dry sand. In this photo the claw marks are not visible.

Figure 35 shows a short set of Harrier tracks walking around near a nest. Toe two, the middle toe that faces forward, often has a somewhat curved appearance. Harriers usually land close to the nest bowl but may walk a short distance away. Normally harriers do not roam about as corvids or Great Horned Owls may.

Figure 36 shows a plover nest depredated by a harrier. Plover tracks are all around the nest bowl, but inside the nest bowl you can see the partial track of a harrier at the top of the nest

bowl. Eggshell fragments are around the nest bowl, and a light amount of egg content material stains the sand at the bottom of the nest bowl. A mostly developed chick is dead lying on the sand above the nest bowl. Sometimes it is difficult to see a harrier track because the plovers return to the nest to see if any eggs remain, and they walk over the harrier track.

Figure 37 shows a plover nest depredated by a harrier. Note the single egg remaining after a harrier partially depredated the nest. The plovers shifted the nest bowl to the right of the original location. The remains of a crushed chick can be seen in the original nest location to the left. Adult plovers may continue to incubate a nest if any eggs remain after a depredation. In some cases the harrier will return to the plover nest at a later time and consume the remaining eggs.

Peregrine Falcons are residents on the Oregon coast with birds present throughout the year. They are commonly observed on plover nesting beaches throughout the breeding season. They have not been documented as nest predators, nor have we directly observed them depredating adult plovers however we have found the remains of plover carcasses that were likely depredated by falcons, possibly Peregrines. They regularly are observed hunting shorebirds, waterfowl, seabirds and other species while on the beach, and have been observed with shorebirds in their talons while perched on stumps on the beach. Although their prey consists almost entirely of birds, they tend to take larger species, i.e. gulls, pigeons, waterfowl or larger shorebirds. We have observed Peregrines hunting juvenile California Gulls on a regular basis later in the nesting season.

Figure 38 shows a Peregrine Falcon track. Falcons, like other raptors, have wide, robust toes with three facing forward and one backward. The fourth toe claw may drag. The fourth toe, which faces backward, has an indentation from the claw, and a drag mark that follows. The footprint measures 10cms, and nail to nail the print measures 12-14cms.

Peregrine tracks look similar to an owl track in thickness but differ with three toes facing forward, unlike the two toes forward from an owl track. While Great Horned Owls will often walk a distance on the sand, falcons typically do not.

Figures 39 and 40 show Peregrine Falcon tracks. The side-by-side tracks are from landing or standing on the beach.

American Kestrels (*Falco sparverius*) are uncommonly observed on the beach during the breeding season. Kestrels have been observed perching on woody debris, signs, and exclosures. In one case a Kestrel was observed perching on an exclosure where an adult was depredated; plover feathers were found stuck to the exclosure and the surrounding habitat. Merlins (*Falco columbarius*) are commonly observed annually also, but are mostly observed during the migration season. Merlins often fly very low over the nesting habitat or along the foredune. Both Kestrels and Merlin tracks look similar to Peregrine tracks, but are considerably smaller. Both of these species are rarely observed on the ground, and we have never taken any photos of their tracks.

For comparison, Figures 41 – 44 show the similarities and differences of Common Raven (Figure 41), Northern Harrier (Figure 42), Great Horned Owl (Figure 43), and Peregrine Falcon (Figure 44). The differences are subtle but noticeable; note the placement/direction of the toes, the thickness of the toes, and the overall appearance of each track.

Turkey Vultures are summer residents along the Oregon coast and are often observed feeding on dead birds, marine mammals, or fish carcasses. Vultures will sometimes associate with eagles or ravens around carcasses. Vultures have not been documented eating plover eggs or chicks in Oregon. There have been instances where a carcass has washed up onto a beach close to a plover nest, and vulture tracks are noted within very close proximity to an active nest without disturbing the plover nest. We include their tracks as they are commonly observed on the beach, and to explain the difference between vultures and other raptors that are regularly observed.

Figure 45 shows a set of Turkey Vulture tracks. There are three toes facing forward, one toe facing backward, and the front toes often leave nail marks. Vulture tracks measures from 8.5-10cms, and from nail to nail the overall track is 12.5-21cm long. Eagles and corvids also drag their toes/nails leaving marks in the sand. Vultures' toes are thick and robust, and the rear toe is the shortest toe of any avian track. While vulture tracks can be similar to a Great Horned Owl or Peregrine Falcon, they are easily differentiated from an owl by having three of the four toes face forward. Vulture tracks are different from falcon tracks as they are thicker and wider, and vultures have a tendency to walk around extensively when they have found a food source. Falcons generally kill their prey in the air and land on the ground or a stump to eat. Falcon tracks may be observed around the remains of a carcass but they do not walk distances on the sand.

Figure 46 shows a set of vulture tracks walking around on the sand.

Whimbrels (*Numenius phaeopus*) are observed on Oregon beaches throughout the nesting season. Whimbrels are common along the coast particularly on beaches near ranchlands with a mixture of pasture and wetland habitat which they often utilize. They are often observed in small numbers, foraging in the wrackline for invertebrates. Whimbrels have not been recorded as egg or chick predators, but are included to show what their track looks like since they are regularly observed. Whimbrels often walk around and forage in the dry sand, often within close proximity to plover nests.

Whimbrels' diet is comprised of mostly of marine invertebrates, including crabs, crustaceans, marine worms, mollusks, and fish (Marshall et. al., 2003). Whimbrels have long probing bills but they are visual feeders that pick at prey on the surface or just below the sand as they walk on the beach (Paulson 1993). Whimbrels have not been noted harassing adult plovers at a nest, nor have we documented that they are a threat to the adults or the eggs.

Figures 47 - 50 show Whimbrel tracks on dry sand. Similar to other curlews and sandpipers, they have three widely spaced toes pointing forward, and one toe rearward that is often very light or only the nail point is visible. They can appear similar to Turkey Vulture tracks but are smaller. They drag their nails in some cases, similar to a vulture, but the drag marks are usually

not as prominent or long. The track size ranges from 4-8cm, averaging 6cm, which is often the measurement when the back toe is difficult to observe. Whimbrel tracks are very similar to Snowy Plover tracks, except plover tracks are smaller, measuring approximately 2cm long.

Mammalian Species

Mammalian predators that have been documented depredating plover nests include coyotes, fox, raccoon, and skunk. Mice have also been documented depredating plover eggs. Several other mammalian species are present on plover nesting beaches. We include descriptions of their tracks and behaviors for comparison to known mammalian plover nest predators.

Coyotes (*Canis latrans*) are more common on the northern sites of the plover project area, but do occur on the south sites. Both red (*Vulpes vulpes*) and gray fox (*Urocyon cinereoargenteus*) are present on plover nesting beaches in southern Oregon. Their tracks are similar in appearance with slight differentiations; like all canids the front foot is larger than the hind (Halfpenny 2008).

Coyotes are year-round residents along the Oregon coast. Coyote dens have been located in areas adjacent to, and in some cases within close proximity to nesting plovers. Wildlife Service staff have also found Coyote dens on the plover nesting areas. Coyotes are pack animals, therefore there are often tracks from multiple individuals. Coyotes have been documented as plover nest predators using field cameras, and their tracks have been found leading up to, and away from nests. Coyotes eat a wide variety of prey; they forage for rodents, small and large mammals, birds, carrion, fruit and insects (Macdonald 1984).

Coyotes are relatively common from Sutton to Coos Bay North Spit, but are uncommon to rare in the Bandon to Floras Lake area.

Figure 51 shows a set of coyote tracks. Four toes are visible with claw marks that are usually present. The front feet are larger than the back feet. There is one lobe on the leading edge of the interdigital pad (Halfpenny 2008). Coyote tracks are larger than fox tracks, and slightly more angular than a dog track. The actual print size varies, especially on the sand; the print measures 8-11cm. Coyotes are one of the heavier mammals on the beach, causing their prints to be larger than on a hard surface.

Figure 52 shows a meandering set of coyote tracks. The tracks are typical of patterns of coyote tracks on the beach, often zig-zagging east to west.

Coyotes, like all canids, are messy around depredated plover nests due to their four legs and weight. Evidence at the nest site is obvious. Tracks leading up to and away from the nest are prominent, and they often alter the nest bowl. Coyotes crush the eggs leaving some eggshell pieces scattered around the nest bowl. They often stomp around the nest bowl, sometimes partially burying pieces of eggshell in the sand. Eggshell pieces are not found at all coyote depredated nests. Nest material brought into the nest bowl is usually altered in some manner as the coyotes use their feet to dig into the nest bowl. In some cases, some of the egg contents

may be clumped in the sand. They may defecate and leave a pile of scat in the nest bowl, or sometimes close to it.

Figure 53 shows a coyote depredation around a nest site. Coyote tracks have trampled all the habitat, and it is difficult to see where the nest bowl was located.

Figure 54 shows a close up of a piece of an eggshell pushed into the sand due to trampling by a coyote. Light staining of the sand around the eggshell fragment is from spilled yolk.

Figure 55 and 56 show two more nests sites depredated by coyotes. Both photos show extensive disturbance by the coyote around the nest bowl.

Figure 57 shows coyote tracks along the edge of the foredune where adult plovers are often brooding their chicks. Plover tracks can be seen in the photo also. Note at the bottom of the photo, the coyote appears to have lept at something, slightly skidding in the sand.

Red fox are common in the Bandon and New River area, and have been recently detected at Coos Bay North Spit (one was removed around the nesting areas at Coos Bay North Spit in 2016 and two other individuals were documented on the spit away from the nesting area; Bell 2016). Red fox were introduced to the south Oregon coast. Dens of red fox have been documented in the dunes at New River. Red fox forage along the wrackline and adjacent habitat, while gray fox tends to stay closer to the edge habitat, riparian corridors, or more thickly vegetated areas. Gray fox are slightly smaller than red fox. Both species are opportunistic foragers; they eat rodents, small mammals, birds, eggs, fruit, insects, and invertebrates (Macdonald 1984). Both species have been documented depredating plover eggs along the Oregon Coast. Red fox have attempted to dig under exclosures. Red fox have been documented depredating adult plovers around nests at New River.

Figure 58 shows a red fox track. There are four toes with claw marks, and the interdigital pad has a callus ridge on the sole of the foot. The callus ridge on the pad appears as a thin horizontal line. This characteristic of the track is often difficult to detect especially on the hind foot, but can be observed more often on the larger front foot. It is also difficult to detect in dry sand. Claw marks are usually visible, but often not all four are visible. Red fox tracks measure 5.5-6.5cm long, but there is variation depending on the sand. They can overlap in size with gray fox, and they may overlap with small, immature coyotes.

Figure 59 shows a red fox track next to a ruler in a notebook. Compare with Figure 67 of a gray fox.

Figure 60 shows both a front and back footprint of a red fox. The top track is the back foot, the smaller of the two prints. The interdigital pad appears to be small, and is somewhat round with no visible callus. Claw marks are visible. The bottom track is the front foot; the pad and callus are visible.

Red fox can travel long distances hunting in search of food, often traversing miles of beach habitat in one night. They run in and out of the dunes, foraging along the beach and adjacent habitats, open spits and managed plover nest areas. Red fox weave around European beachgrass (*Ammophila arenaria*) dominated dune habitat at Bandon and New River.

Figure 61 and 62 show red fox activity around a goose carcass at New River. Fox will zig zag, run, pounce, dig deep holes, and drag items around while hunting. These situations help to identify the presence of fox that may also be depredating plover nests at Bandon or New River. Figure 63 shows evidence of red fox activity around a depredated plover nest. No eggshells or nest bowl are visible.

Figure 64 shows evidence of red fox activity around a depredated plover nest. Note the skid marks where the fox leapt at something.

Figure 65 shows red fox tracks around a small pile of dried beachgrass. The nest bowl was several meters away and not visible in the photo. The small white object in the beachgrass is a piece of a plover eggshell. Fox will sometimes cache eggs a short distance from the depredated nest site.

Gray fox are native residents of wooded areas along the coast but occasionally wander onto the beach and adjacent plover nesting areas. Gray fox have been documented depredating plover nests. They are slightly smaller than a red fox and are able to retract their claws so they can climb trees. Gray fox tracks often do not show any claw marks, and their toes are broadly spaced apart. The general appearance of both species of fox tracks are very similar and sometimes difficult to differentiate, especially if the tracks are in dry sand and poorly defined. Gray fox tracks measure 4.5-5.5cm long, and the individual toes are more broad than red fox which tend to be more elongated.

Figure 66 shows a gray fox track. The track size is smaller and broader than that of a red fox. There are two light marks from the claws but they are difficult to see in this photo especially compared to the photo of the red fox.

A gray fox track could potentially look similar to a bobcat, but bobcats are very rare on the beach. The prints differ along the leading edge of the interdigital pad: a bobcat has two lobes, but both species of fox only have one lobe (Halfpenny 2008). Bobcat tracks are rounded and not as angular as fox.

Figure 67 shows a gray fox track next to a ruler in a notebook. The gray fox track is smaller than a red fox, and lacks the ridge of callus, which is visible on a red fox print (Figure 58). The gray fox does not have distinct claw marks like the red fox.

Domestic dogs (*Canis lupus*) are common on Oregon beaches at all times of year. Dogs are prohibited in active plover nesting areas, but at times people with dogs walk in places where dogs are not permitted. Dog tracks are included in this document to compare their tracks to wild canines that occur on Oregon beaches. Domestic dog tracks are much more rounded in appearance than wild canines. Size is not as important as shape with domestic dogs because size will range from very small to very large depending on the type of dog.

Figure 68 shows a typical domestic dog track. Note the round shape and distinct toe nail marks.

California ground squirrels (*Otospermophilus beecheyi*) are residents along the Oregon coast in and around the plover nesting habitat. Where they occur, they are often noted along the edge habitat and closely associated with vegetation and woody debris. Ground squirrels do

not spend much time on the open beach, but their tracks may be observed along the foredune. They will dig holes and burrow in the sand and they may have multiple openings and runways that lead into their burrows. They are often observed perched on short shrubs or large woody debris along the grassy edge. Ground squirrels' diets consist of vegetation, seeds, nuts, berries, birds, eggs, and insects (Burt and Grossenheider 1976). Even though ground squirrels' diets do include eggs, we have not documented ground squirrels depredating plover eggs. They are included in this document because they are regularly observed, and may be confused with skunk or other small mammals.

Figure 69 shows ground squirrel footprints. The front foot is the smaller foot with four toes, and their back foot is the larger foot with five toes. Their tracks measure between 3-5.5cm, depending on if the sand is wet or dry. The average print is 3-4cm. Their heel and tracks are visible as long as the sand is firm; if it is dry their tracks appear more circular. Their long claws are clearly visible.

Skunk and ground squirrel tracks overlap in size. Skunk tracks are slightly smaller, even though skunks weigh more than a squirrel. Skunks walk therefore their tracks follow a straight line, though the line may meander. Ground squirrels bound.

Figure 70 and 71 show ground squirrel prints on dry sand. They have a more rounded appearance in dry sand compared to wet sand. Their bounding stride is shown in the picture. No nail marks are visible in the photos.

Mice are present at all sites where plovers nest along the Oregon coast. Both deer mice (*Peromyscus maniculatus*.) and Pacific jumping mice (*Zapus trinotatus*) are year-round residents. They live in high concentrations around the habitat where plovers nest. Their tracks are regularly observed, and they burrow under the vast supply of woody debris on the managed plover habitat. Their tracks are commonly seen moving between pieces of wood.

Mouse tracks usually appear to be bounding. Their four feet are tiny, and their front feet are smaller than the rear. Their front feet have four toes and the back feet have five toes.

The diet of mice is largely comprised of seeds, but they also eat nuts, and acorns (Burt 1976). Mice also eat eggs, and we have photo documented mice depredating plover eggs from exclosed nests. There is an abundance of food on the nesting areas for mice due to the presence non-native vegetation. Both the grass seed and *Cakile maritima* seeds provide a wealth of seed resources for rodents, and woody debris provides burrowing habitat for reproduction.

Figure 72 shows mouse tracks. The four feet and toes are clearly visible. Their tracks measure 1.5-2cm long. A clear front foot is in the middle with four toes. The two prints that are slightly wider prints are the back feet. Being light weight, their tracks can be faint, and often do not show the toe marks or a clear pad print. Weather can also obscure their tracks.

Figure 73 and 74 show typical mouse prints. All four feet are visible, but they appear as round marks on the sand. They measure approximately 1cm long.

Figure 75 shows the remains of a plover egg that was depredated by a mouse. There are tiny pieces of crushed eggshell fragments (the white bits of material under the log), and the darker clumped pieces of material are crushed pieces of embryo material. The nest was a short distance away, and mouse tracks and plover tracks were around the nest bowl area, but faint.

Figure 76 shows cached seeds of a mouse by a log. Mouse tracks are visible around the seed collection and along the right top corner of the picture

Virginia opossum (*Didelphis virginiana*) are non-native year-round residents in Oregon. They are uncommon on the beach. An opossum-depredated plover nest was documented for the first time in 2016. Opossums' diet consists of fruit, nuts, insects, small invertebrates, eggs, carrion, and garbage.

Figure 77 shows a set of Opossum tracks, one stepping on the other. The track on the left side of the photo shows a front foot, and the track stepping over it is the hind foot. Their track measures approximately 7.5cm in the sand. Opossum have five toes on each foot. The front foot is wider than long, with thick robust toes. Their tracks are distinctive due to the hind foot that has an opposable toe that protrudes sideways from the other toes (Halfpenny 2008).

Figure 78 shows the walking stride of an opossum. They meander like a skunk or raccoon. Due to their opposable toe on the hind foot, their track is distinctive and hard to confuse with something else.

River otter (*Lontra canadensis*) are coastal residents in Oregon that are observed regularly at sites with associated creeks and rivers including New River, Bandon Beach, Tenmile, Tahkenitch and Siltcoos. They are not observed at all the beaches where plovers nest in Oregon since otters primarily spend their time in water. They are not a documented threat to plovers, but they are included in this document because their tracks may potentially be confused with raccoon or opossum.

Otters consume frogs, crayfish, crabs, and fish, or other aquatic invertebrates (Macdonald 1984, Bart 1976). They are highly social creatures, often seen in family groups. They may come close to active plover nests, but they generally do not pose a threat.

Figure 79 shows river otter tracks. Otters have large webbed feet. The webbing is difficult to see on the sand but the broad, robust size of their toes and feet make their track distinctive. An otter track measures 7.5-8cm. Both the front and rear feet have five toes; the rear foot is larger.

Figure 80 shows the loping stride of a river otter. The track has a slightly angled appearance, which is very typical. Otters have long tails but they do not normally drag them on the sand.

Porcupine (*Erethizon dorsatum*) are year residents along the Oregon coast. They frequent both the managed nesting habitat and beaches on a regular basis during the plover breeding season, but they are not a threat to the plovers. In a few cases an individual porcupine has stepped close to a nest, but they did not harm the eggs.

Porcupines are primarily vegetarian. They forage on buds, small twigs, roots, bulbs, and the inner bark of trees. Salt is also an important part of their diet, which is the reason they forage on the beach (Burt 1976, Macdonald 1984).

Figure 81 shows a porcupine track. There is a “messy” appearance to their tracks due to their heavy, stocky body on short legs, with long hair and quills dragging on the sand. Occasionally, you can see the drag mark of their tail. Porcupines have “nubs” on the soles of their feet that create a rough texture (Halfpenny 2008). Porcupine have four toes on the front feet and five toes on the hind foot. Their toe prints are sometimes difficult to detect, but their claw marks often show. Their hind foot is larger than their front foot. Track size is variable, depending on weight, and ranges from 7-10cm in length.

Porcupines often visit the beach but they have a tendency to stay close to the edge of the foredune, near the vegetated habitat.

Figure 82 shows the walking stride of a porcupine. This set of tracks is a relatively straight line; when there is vegetation or woody debris, they will meander.

Raccoons (*Procyon lotor*) are residents along the coast in Oregon, and occur at all the beaches where plovers nest. They are an omnivorous, opportunistic predator, and have a broad ranging diet that includes eggs (Bart 1976, Macdonald 1984). They have depredated plover nests at many nesting areas. Raccoons do not actively hunt plover nests, but will depredate nests when they opportunistically find them.

Figure 83 shows a raccoon track. Raccoons have five slender toes on all four feet that are slightly bulbous at the ends. Their two hind feet have a long bare heel. Their long slender toes make them very dexterous. They use their two front paws like human hands, and their paws are very sensitive. A raccoon track measures 5-8cm; the variation occurs due to weight and size of the individual and the moisture in the sand. When a raccoon depredates a nest, they often dig in the nest bowl.

Fox or otter tracks may possibly be confused with raccoon tracks. Both species of fox only have four toes on each foot, and their toes are not as long as a raccoon. Otter have five toes on each foot, and are thick and robust, but not as long. The raccoon’s stride is often a gallop, much different from both fox and otter strides. Both species of fox trot, and the track appears as a line. An otter has a loping stride, and their tracks show as set of four that run on an angle.

Figure 84 shows a raccoon’s hopping stride. Note the length of the toes. Raccoons roll their hips forward while walking causing the hind foot to register beside the opposite front foot (Halfpenny 2008).

Skunk are year-round residents along the Oregon coast, and their tracks are regularly observed on beaches where plovers nest. They are largely carnivorous, with insects and small mammals as their primary food source. They also forage on small birds, eggs, grubs, berries, and carrion (Macdonald 1984, Burt 1976). The most common skunk on the beach is striped skunk (*Mephitis mephitis*). spotted skunk (*Spilogale gracilis*) is also present but has been rarely documented.

Skunk tracks weave along the edge of the foredune and onto the nesting areas, and they often come within close proximity to active plover nests. Skunks seem to be most common at the two southern-most plover sites, Bandon and New River, which is where we have documented the most skunk predations.

Figure 85 shows skunk tracks. Skunk are about the size of a house cat. They have relatively small feet, with long front toes, and large claws. All four feet have four toes. Their tracks measure 3-4.5cm on the sand. This photo is on dry sand; most of the tracks do not show claw marks except the two tracks in the top right corner.

Skunk tracks could potentially be confused with California ground squirrels. They occupy similar trails and habitat. Both species burrow underground and den, and they also both use the habitat just west of the foredune.

Figure 86 shows skunk tracks along the foredune. The skunk tracks are close to the edge of the foredune by a piece of dried kelp. Plover tracks can also be seen in this photo.

Figure 87 shows the walking stride of a skunk. Note how the track is in a straight line, unlike a squirrel's where the feet are spread out. Skunks often walk in straight lines as in the photo, but may also meander around on the beach.

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Figure 1. Map of Snowy Plover project area in Oregon from Sutton Beach, Lane Co., to Floras Lake, Curry Co.

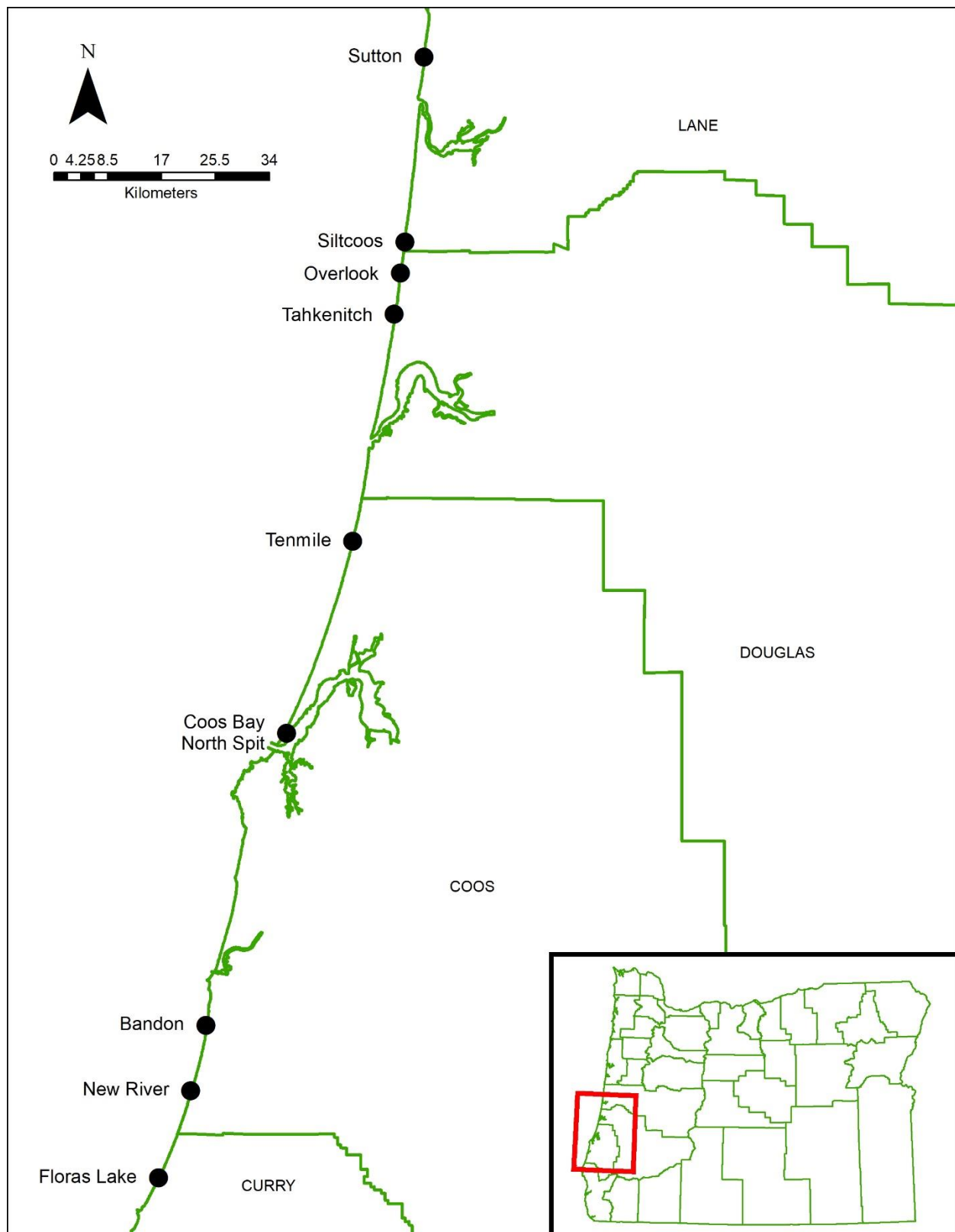


Figure 2. Bald Eagle footprint. Size ranges from 15-16.5 cm long nail to nail. The toe print is very broad and deep in sand. Three toes are forward, and one toe is back. Nail marks can be noted in the front and back. Drag marks from the nail are prominent.



Figure 3. Bald Eagle tracks walking on sand. Note there are three toes forward with the front of the back toe print prominent, and the back nail leaving a consistent drag mark in the sand.



Figure 4. Common Raven. The track size is between 8-10.5cm (not including the nail marks) and 15-21cm (with the nail marks). There are three toes forward and one toe backward. Note the segmented appearance and the toe nail drag, in this case on the front toe.



Figure 5. Common Raven. Note the nail is dragging on the back toe in Figure 5.



Figures 6. Raven tracks around tidal debris.



Figure 7. Raven tracks around kelp strand. Note how they peck at and move the kelp.



Figure 8. Raven tracks around a plastic bottle on beach. The raven flipped the bottle on it's end.



Figure 9. Raven tracks around marine debris. Note how they moved and flipped some of the debris.



Figure 10. Raven tracks around driftwood.



Figure 11. Raven tracks at a depredated plover nest.



Figure 12. Raven tracks at a depredated plover nest. Ravens tend to be messy around a nest site, sometimes digging into the nest bowl, walking around repeatedly, turning things over, or pecking at pieces of wood. They normally swallow eggs whole so there is typically no evidence of the eggs.



Figure 13. American Crow track. Note the well defined track with a segmented pad, and detached nail mark in front of the middle toe. The pad part of the track is 7cm long, and with the nail marks 8.5cm long. It is very similar to a raven track but both the pad and the toe length is smaller.



Figure 14. American Crow track. Note the lack of segmentation from the toe pads, the middle pad of the foot is not visible, and the nail marks are visible at the tips of toes.



Figure 15. American Crow track. Note the lack of segmented toe pads. Nail marks are visible at the tips of toes, and in this case the rear toe nail has left a drag mark.



Figure 16. Gull track. Note toes two to four are clearly shown with the webbing between the toes. Toe one, the rearward toe, faintly shows the mark of the claw. Different gull species tracks appear the same visually but would show differences in size and walking stride.



Figure 17. Western Gull track on wet sand (compact and hard); the webbing between toes two to four is not visible.



Figure 18. This photo shows a typical walking stride of a set of gull tracks.



Figure 19. Photo of gull tracks around the remainder of an empty nest bowl. A light amount of faint plover tracks are visible around the nest bowl, as well as gull tracks.



Figure 20. Gull tracks walking away from a depredated nest.



Figure 21. An empty plover nest bowl that was recently depredated, with both plover and gull tracks visible.



Figure 22. Gull tracks and plover tracks at a depredated nest site (not visible in photo). The plover tracks have a path to the nest, and the gull appears to have landed, swallowed the eggs, and walked off.



Figure 23. The picture below shows a depredated plover nest. Note the empty nest bowl, well defined gull tracks, and a light amount of plover tracks coming and going from the nest.



Figure 24. Heron tracks are the largest avian track likely to be seen on the beach, and are larger than Bald Eagle tracks. A Great Blue Heron track is approximately 16 cm long. The individual toes of a heron are not as broad as an eagle. Herons have three toes forward and one toe backward, and they have offset toes.



Figure 25. The walking stride of a Great Blue Heron. Note the fairly straight line of tracks and the lack of nail drag marks. Heron tracks have a slightly wider gape than eagles.



Figure 26. Multiple tracks of a Great Blue Heron standing in one location.



Figure 27. Great Horned Owl tracks. Note the two toes facing forward are close together, the third toe is off to the side, and the fourth toe is facing back. Owls have relatively thick toes compared to other species of similar size.



Figure 28. Great Horned Owl track. Note the two toes facing forward are close together, the third toe is off to the side, and the fourth toe is facing back.



Figure 29. Great Horned Owl tracks walking a short distance in the sand. Note the owl tracks cross over a set of plover tracks. Owls will land on the beach and may briefly walk around, and in some situations the owl will fly a short distance to another location where their tracks will be observed again.



Figure 30. Great Horned Owl tracks.



Figure 31. Depredated Snowy Plover egg from a Northern Harrier. Note the crushed egg and spilled egg content.



Figure 32. Depredated Snowy Plover egg from a Northern Harrier with a dead nearly fully developed plover chick.



Figure 33. Northern Harrier track. Note toes two to four point forward and toe one points backward, with nail marks at the tips of each toe. Harriers differs from owls by having three toes pointing forward; owls have two toes pointing forward. The track length of a harrier print is ca. 7.5-9 cm long.



Figure 34. Northern Harrier track on dry sand; in this case the claw marks are not visible.



Figure 35. Northern Harrier tracks walking around near a plover nest. Toe two, the middle toe that faces forward, often has a somewhat curved appearance. Harriers usually land close to the nest bowl but may walk a short distance away. Normally harriers do not roam about compared to corvids or Great Horned Owls.



Figure 36. Plover nest depredated by a harrier. Plover tracks are all around the nest bowl, but inside the nest bowl you can see the partial track of a Harrier at the top of the nest bowl. Eggshell fragments are around the nest bowl, and a light amount of egg content material stains the sand at the bottom of the nest bowl. A mostly developed chick is dead lying on the sand above the nest bowl. Sometimes it is difficult to see a harrier track because the plovers return to the nest to see if any eggs remain, and they walk over the harrier track.



Figure 37. Depredated plover nest by a Northern Harrier. Note the single egg remaining after a harrier partially depredated the nest. The plovers shifted the nest bowl to the right of the original location. The remains of a crushed chick can be seen in the original nest location to the left. Adult plovers may continue to incubate a nest if any eggs remain after a depredation.



Figure 38. Peregrine Falcon track. Falcons, like other raptors, have wide, robust toes with three facing forward and one backward. The fourth toe claw may drag. The fourth toe, which faces backward, has an indentation from the claw, and a drag mark that follows. The footprint measures 10cms, and nail to nail the print measures 12-14cms.



Figure 39. Peregrine Falcon tracks. The side by side tracks are from landing or standing on the beach.



Figure 40. Close up of Peregrine Falcon tracks.



Figure 41. Common Raven tracks for comparison with Northern Harrier (Figure 41), Great Horned Owl (Figure 43), and Peregrine Falcon (Figure 44). The differences are subtle but noticeable; note the placement/direction of the toes, the thickness of the toes, and the overall appearance of each track.



Figure 42. Northern Harrier track for comparison with Common Raven (Figure 41), Great Horned Owl (Figure 43), and Peregrine Falcon (Figure 44).



Figure 43. Great Horned Owl tracks for comparison with Common Raven (Figure 41), Northern Harrier (Figure 42), and Peregrine Falcon (Figure 44).



Figure 44. Peregrine Falcon tracks for comparison to Common Raven (Figure 41), Northern Harrier (Figure 42), and Great Horned Owl (Figure 44).



Figure 45. Turkey Vulture tracks. There are three toes facing forward, one toe facing backward, and the front toes often leaves nail marks. Vulture tracks measures from 8.5-10cms, and from nail to nail the overall track is 12.5-21cm long.



Figure 46. Turkey Vulture tracks walking around on the sand.



Figure 47. Whimbrel tracks on dry sand. Similar to other curlews and sandpipers, they have three widely spaced toes pointing forward, and one toe rearward that is often very light or only the nail point is visible. They can appear similar to Turkey Vulture tracks but are smaller. They drag their nails in some cases, similar to a vulture, but the drag marks are usually not as prominent or long. The track size ranges from 4-8cm, averaging 6cm, which is often the measurement when the back toe is difficult to observe. Whimbrel tracks are very similar to Snowy Plover tracks, except plover tracks are smaller, measuring approximately 2cm long.



Figure 48. Numerous lines of Whimbrel tracks.



Figure 49. Whimbrel tracks.



Figure 50. Whimbrel tracks.



Figure 51. Coyote tracks. Four toes are visible with claw marks that are usually present. The front feet are larger than the back feet. There is one lobe on the leading edge of the interdigital pad (Halfpenny 2008). Coyote tracks are larger than fox tracks, and slightly more angular than a dog track. The actual print size varies, especially on the sand; the print measures 8-11cm.



Figure 52. A meandering set of coyote tracks. The tracks are typical of patterns of coyote tracks on the beach, often zig-zagging east to west.



Figure 53 shows a coyote depredation around a nest site. Coyote tracks have trampled all the habitat, and it is difficult to see where the nest bowl was located.



Figure 54 shows a close up of a piece of an eggshell pushed into the sand due to trampling by a coyote. Light staining of the sand around the eggshell fragment is from spilled yolk.



Figure 55. Plover nest site depredated by coyote. Note the extensive coyote tracks and the disturbed nest bowl under the tuft of grass.



Figure 56. Plover nest site depredated by coyote. Note the extensive coyote tracks leading up to and around the nest bowl.



Figure 57. Coyote tracks along the edge of the foredune where adult plovers are often brooding their chicks. Plover tracks can be seen in the photo also. Note at the bottom of the photo, the coyote appears to have lept at something, slightly skidding in the sand.



Figure 58. Red fox track. There are four toes with claw marks, and the interdigital pad has a callus ridge on the sole of the foot. The callus ridge on the pad appears as a thin horizontal line. This characteristic of the track is often difficult to detect especially on the hind foot, but can be observed more often on the larger front foot. It is also difficult to detect in dry sand. Claw marks are usually visible, but often not all four are visible. Red fox tracks measure 5.5-6.5cm long, but there is variation depending on the sand. They can overlap in size with both gray fox and coyotes.



Figure 59. Red fox track with ruler. Compare to a gray fox in Figure 66.



Figure 60. A front and back footprint of a red fox. The top track is the back foot, the smaller of the two prints. The interdigital pad appears to be small, and is somewhat round with no visible callus. Claw marks are visible. The bottom track is the front foot; the pad and callus are visible.



Figure 61. Red fox activity around a goose carcass at New River. Fox will zig zag, run, pounce, dig deep holes, and drag items around while hunting.



Figure 62. Red fox activity around a goose carcass at New River. Fox will zig zag, run, pounce, dig deep holes, and drag items around while hunting.



Figure 63. Evidence of red fox activity around a depredated plover nest. No eggshells or nest bowl are visible.



Figure 64. Red fox activity around a depredated plover nest. Note the skid marks where the fox leapt at something.



Figure 65. Red fox tracks around a small pile of dried beachgrass. The nest bowl was several meters away and not visible in the photo. The small white object in the beachgrass is a piece of a plover eggshell. Fox will sometimes cache eggs a short distance from the depredated nest site.



Figure 66. Gray fox track. The track size is smaller and broader than a red fox. There are two light marks from the claws but they are difficult to see in this photo especially compared to the photo of the red fox.



Figure 67. Gray fox track next to a ruler in a notebook. The gray fox track is smaller than a red fox, and lacks the ridge of callus, which is visible on a red fox print (Figure 58). The gray fox does not have distinct claw marks like the red fox.



Figure 68 shows a typical domestic dog track. Note the round shape and distinct toe nail marks.



Figure 69. California ground squirrel footprints. The front foot is the smaller foot with four toes, and their back foot is the larger foot with five toes. Their tracks measure between 3-5.5cm, depending on if the sand is wet or dry. The average print is 3-4cm. Their heel and tracks are visible as long as the sand is firm; if it is dry their tracks appear more circular. Their long claws are clearly visible. They have a bounding stride as shown in the picture.



Figure 70. California ground squirrel prints on dry sand. Note the more rounded appearance in dry sand compared to wet sand. The bounding stride as shown in the picture.



Figure 71. California ground squirrel prints on dry sand. Note the more rounded appearance in dry sand compared to wet sand. No nail marks are visible.

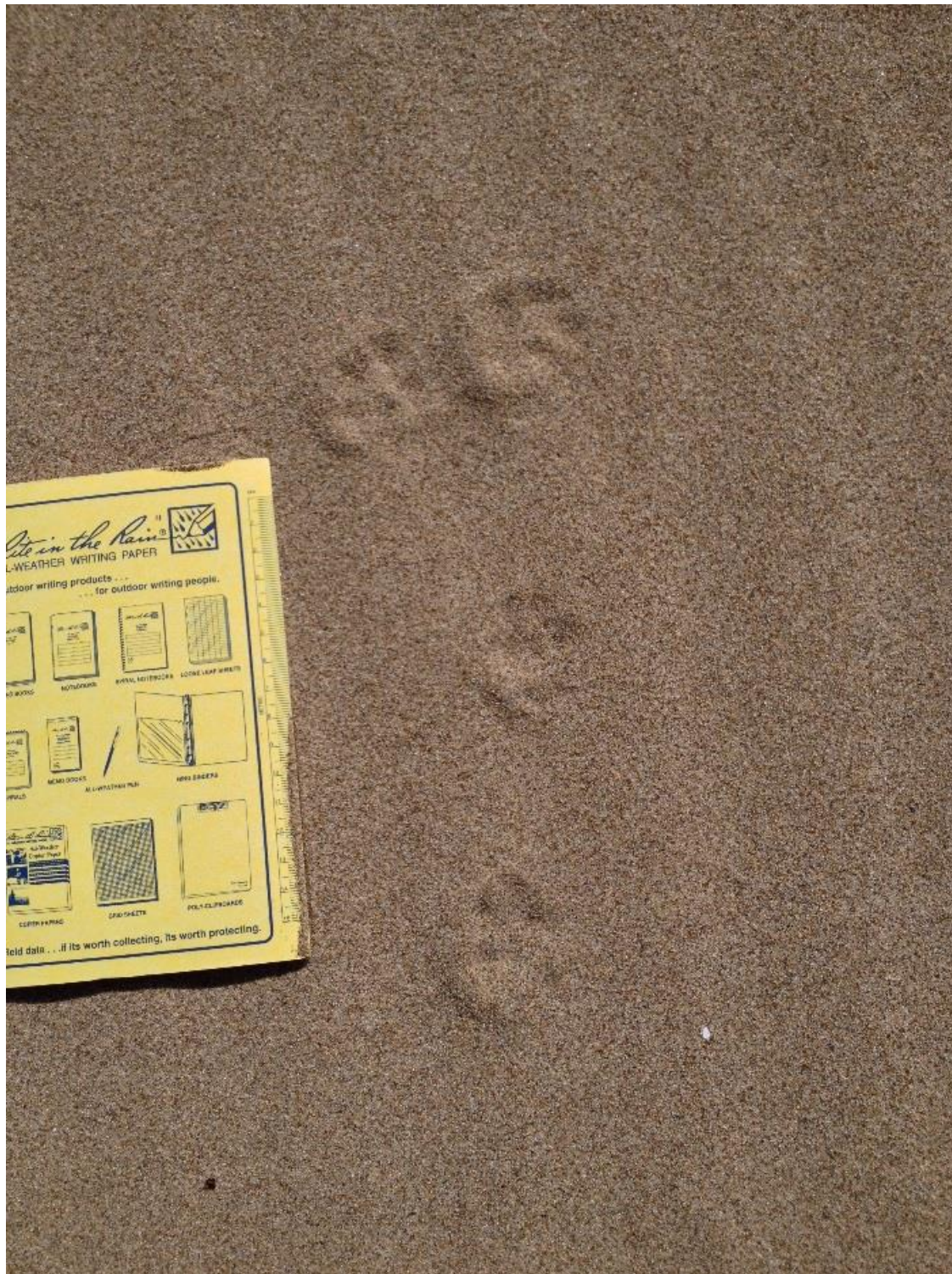


Figure 72. Mouse tracks. The four feet and toes are clearly visible. Their tracks measure 1.5-2cm long. A clear front foot is in the middle with four toes. The two prints that are slightly wider prints are the back feet.



Figure 73. Mouse prints. All four feet are visible, but they appear as round marks on the sand. They measure approximately 1cm long.



Figure 74. Mouse tracks in soft dry sand. Note the bounding stride.



Figure 75. The remains of a plover egg that was depredated by a mouse. There are tiny pieces of crushed eggshell fragments (the white bits of material under the log), and the darker clumped pieces of material are crushed pieces of embryo material. The nest was a short distance away, and mouse tracks and plover tracks were around the nest bowl area, but faint.



Figure 76. Cached seeds of a mouse by a log. Mouse tracks are visible around the seed collection and along the right top corner of the picture. There is an abundance of food on the plover nesting habitat and woody debris to burrow under and reproduce, this habitat is ideal for mice.



Figure 77. Virginia opossum tracks. The track on the left side of the photo shows a front foot, and the track stepping over it is the hind foot. Their track measures approximately 7.5cm in the sand. Opossum have five toes on each foot. The front foot is wider than long, with thick robust toes. Their tracks are distinctive due to the hind foot that has an opposable toe that protrudes sideways from the other toes



Figure 78. The walking stride of a Virginia opossum. They meander like a skunk or raccoon. Due to their opposable toe on the hind foot, their track is distinctive and hard to confuse with something else.



Figure 79. River otter tracks. Otters' have large webbed feet. The webbing is difficult to see on the sand but the broad, robust size of their toes and feet make their track distinctive. An Otter track measures 7.5-8cm. Both the front and rear feet have five toes; the rear foot is larger.



Figure 80. River otter tracks. Note the loping stride of a river otter. The track has a slightly angled appearance, which is very typical. Otters have long tails but they do not normally drag them on the sand.



Figure 81. Porcupine track. There is a “messy” appearance to their tracks due to their heavy, stocky body on short legs, with long hair and quills dragging on the sand. Occasionally, you can see the drag mark of their tail. Porcupines have “nubs” on the soles of their feet that create a rough texture. Porcupine have four toes on the front feet and five toes on the hind foot. Their toe prints are sometimes difficult to detect, but their claw marks often show. Their hind foot is larger than their front foot. Track size is variable, depending on weight, and ranges from 7-10cm in length.



Figure 82. The walking stride of a porcupine. This set of tracks is a relatively straight line; when there is vegetation or woody debris, they will meander.



Figure 83. Raccoon track. Raccoons have five slender toes on all four feet that are slightly bulbous at the ends. Their two hind feet have a long bare heel. Their long slender toes make them very dexterous. They use their two front paws like human hands, and their paws are very sensitive. A raccoon track measures 5-8cm; the variation occurs due to weight and size of the individual and the moisture in the sand.



Figure 84. A raccoon's hopping stride. Note the length of the toes. Raccoons roll their hips forward while walking causing the hind foot to register beside the opposite front foot



Figure 85. Skunk tracks. Skunk are about the size of a house cat. They have relatively small feet, with long front toes, and large claws. All four feet have four toes. Their tracks measure 3-4.5cm on the sand. This photo is on dry sand; most of the tracks do not show claw marks except the two tracks in the top right corner.



Figure 86. Skunk tracks along the foredune. The skunk tracks are close to the edge of the foredune by a piece of dried kelp. Plover tracks can also be seen in this photo.



Figure 87. The walking stride of a skunk. Note how the track is in a straight line, unlike a squirrel's where the feet are spread out. Skunks often walk in straight lines as in the photo, but meander around on the beach.

